NOTES ON METEOROLOGY AND CLIMATOLOGY

MOUNTAINS AND WINDS

A recent paper by Th. Hesselberg and H. U. Sverdrup, entitled, "Über den Einfluss der Gebirge auf die Luftbewegung längs der Erdoberflache und auf die Druckverteilung,"[1] includes studies of the Appalachians, Alps and Apennines as influencing winds. For the United States 51 weather maps in 1906 were chosen for study. The winds of the Appalachian region exhibit three simple types of influence. (1) With a general flow of air from the northwest there is divergence on the windward side and convergence on the leeward side of the mountains. (2) With a southeast wind there is the same general flow of air around the mountain mass but locally there are converging winds on the windward side. This is said to indicate an air whirl on a horizontal axis there. (3) When there is a general southwest wind parallel with the mountain chain, the winds over the mountains are usually across them from the west. But when the flow is from the northeast, there are no such corresponding winds crossing the mountains. These cross west winds are apparently due to the influence of the upper prevailing westerlies.

Stronger and more complex, mountain influence on crosswise and lengthwise winds was found in Europe, both because of the greater altitude of the mountains and because of more observing stations. With strong cross-mountain flow of air the atmospheric pressure is raised to windward and lowered to leeward, in addition to changes wrought in the wind direction. Cool, wet weather to windward and warm dry weather to leeward followed as a result of the dynamic changes in temperature experienced by the wind in crossing the mountains. In winter locally the mountains become high-pressure, divergence points; while over the valleys low pressure and convergence is the rule. In summer the weather maps indicate a partial reversal of these conditions, since frequently by the time the observations are taken, the diurnal heating of the valleys has already started the up-valley breezes. Thus the wind directions in and about a mountain region are strongly controlled by the presence of the mountains.

[1] Veröff. des Geophys. Inst. d. Univ. Leipzig, 2te Serie, heft 4, Leipzig, 1914, pp. 102–116, 2 pl.

THE INFLUENCE OF METEOROLOGICAL CONDITIONS ON THE PROPAGATION OF SOUND

This study by Dr. H. Bateman[2] includes the effects of wind, temperature, moisture and air composition on the propagation of sound. The general influence of any wind is to reduce the audibility of sounds. The usual greater range of a sound with the wind than against it is ascribed to the increase of wind velocity with altitude, which bends upward the sound waves traveling against the wind and downward those going with the wind. On the other hand, if the upper wind is opposite to the lower one, a sound refracted upward in traveling against the surface wind may be bent to the earth again on entering the other current. This may account for the peculiar regions of silence and sound often observed in easterly surface winds. If the transition from one air current to another is sharp, the boundary may become a reflecting surface.

The temperature effect on sound is much like that of the wind. In the daytime, the normal vertical decrease in temperature leads to refraction of sound waves upward, and the lack of thermal homogeneity of the air aids in dispersing sounds. At night or in cloudy weather, when the temperature is more uniform, sounds are more easily heard. Apparently the lower surface of the stratosphere acts as a reflecting surface which returns to earth heavy sounds such as from artillery fire or volcanic explosions, making spots where such sounds are heard far beyond the limits of direct audibility.

Sounds entering moist masses of air are weakened by "stifling," refraction, scattering and perhaps reflection. Fog usually produces peculiar sound effects, probably on account of temperature differences in the fog

[2] *Monthly Weather Review*, May, 1914, pp. 258–265, 1 fig.

and perhaps also because of sound reflection from the upper limit of the fog. Local interference resulting from such reflection may explain the silent regions so commonly observed in connection with fog signals.

In a similar way, the boundaries between air bodies of different temperatures and humidities in thunderstorms are important in prolonging thunder[3] and in preventing the sound from traveling great distances.[4]

THE THUNDERSTORM AND ITS PHENOMENA

PROFESSOR W. J. HUMPHREYS under the above title has published[5] a careful summary of the present knowledge relative to thunderstorm physics and has added many new points. Professor Humphreys recognizes five types of thunderstorms, which occur as follows: (1) in regions of high temperature and nearly uniform pressure (heat thunderstorms); (2) in the southeast quadrant of an almost circular cyclone; (3) between the branches of a V-shaped cyclone; (4) in the trough between two anticyclones; (5) on the boundary between warm and cold waves. All but the first are produced essentially by the over- and under-running of winds of different temperatures, which in some way cause moist air masses to rise. Each of these types is illustrated with a set of three successive weather maps at 12-hour intervals.

The squall-wind associated with thunderstorms is thought to be the outward flow from a cataract of air which is cooled and kept cold in its descent by the rain or hail falling through it. The sudden rise in air pressure at the onset of a strong thunderstorm is ascribed to the combined effect of the downward thrust, greater density and relatively small absolute humidity of this cold wind, and to the interference which the thunderstorm offers to the free flow of the general winds.

The splitting of raindrops in falling through the ascending air currents characteristic of thunderstorms is, according to G. C. Simpson, the source of the lightning. The small drops with negative charges go up with the wind while the larger ones with positive charges stay below. Thus in a thunderstorm there is usually a region of positive electricity between the negative earth and the negative upper portion of the cloud. When the charge becomes sufficient to ionize a path through the air, a series of direct current discharges usually take place along approximately the same line. A progressive lengthening of a lightning streak in its successive six discharges is shown in a picture taken with a rotating camera (Fig. 26). Professor Humphreys is to be congratulated on his thorough and simple presentation of such a difficult subject.

RAINDROP VELOCITIES[6]

J. LIZNAR in deriving a new mathematical formula for determining the velocities of raindrops has included the effect of the viscosity of the air and friction on the horizontal expanse of the drop. This formula is

$$v = 602.6\sqrt{r} + 57.013 - 33.291r^2,$$

where v is in cm. per sec., r in mm. and atmospheric pressure at 986.6 mb. (740 mm.). Applied to hail this formula becomes

$$v = 20.795(\sqrt{722.2r + 1/r^2} - 1/r).$$

The velocities of raindrops of the radii indicated are roughly as follows:

r 0.5 mm., v 400 cm. per sec.
r 1.0 mm., v 600 cm. per sec.
r 1.5 mm., v 700 cm. per sec.
r 2.7 mm., v 800 cm. per sec. (maximum).

Large drops are retarded by flattening in the air. According to Wiesner's observations this flattening of falling drops will cause those of 3.6 mm. radius to form rings and split into smaller drops.

NOTES

THE June number of the *Monthly Weather Review,* which appeared early in October, has more than 100 pages (quarto), which are devoted mostly to meteorological articles. The

[3] W. Schmidt, *Meteorologische Zeitschrift,* January, 1914, pp. 33–37.

[4] W. J. Humphreys, *Monthly Weather Review,* June, 1914, p. 379.

[5] *Ibid.,* pp. 348–380, 28 figs.

[6] *Meteorologische Zeitschrift,* July, 1914, pp. 339–347.

amount and quality of the meteorological material published in the first six numbers amply justifies the change of this periodical back to its position as the national meteorological magazine.

The daily weather maps of the northern hemisphere issued by the Weather Bureau were discontinued on August 6 on account of lack of European weather reports.

The European meteorological magazines are still being received regularly, although late.

"The Clouds of California," an address by Dr. Ford A. Carpenter before the Occidental College, has been published.[7] The discussion concerns not only the cloudiness of California, but also includes information about the composition and formation of clouds.

W. Bieber[8] has introduced a new factor to explain the blue of the sky. According to him, the action of ultraviolet light forms $NH_4NO_2 + H_2O$, a thin bluish fog in the stratosphere. The blue of the sky is also ascribed to the action on light of dust particles, exceedingly small, snow crystals, air molecules, water vapor and ozone. Recent observations on high mountains show the presence of sufficient ozone alone to account for the sky color.[9]

In Symons's *Meteorological Magazine* for several months there has been a discussion of unusual visibility of distant objects as a prognostic of rain. Haziness is due to the amount and visibility of the dust and other particles in the air and to optical disturbances caused principally by temperature differences. So the cloudiness usually preceding rain reduces dust haziness by cutting off the bright illumination of the particles, and reduces the optical haze by preventing the unequal heating of the lower air and the establishment of convectional currents. However, wind blowing from the direction of a city, which may be even far away, generally makes the air more hazy.[10]

"British Rainfall, 1913" contains rainfall returns from 5,370 stations during the year. Complete daily records were received from 3,370 stations and less complete daily returns from 364 others. For the stations sending these daily records, the density for the British Isles is roughly 42 per 1,000 square miles. The January, 1914, issue of *Climatological Data for the United States by Sections* includes daily rainfall records from 4,391 stations. Thus for the United States, as a whole, the number of rainfall stations is but 1.4 per 1,000 square miles. Even Rhode Island, the state with greatest density of rainfall stations, has but 8 per 1,000 square miles. Nevada has 0.6 for the same area. It is little wonder that the climatic maps of the United States are lacking in detail as compared with the British ones.

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[7] 18 pages. See *Nature*, London, August 6, 1914, p. 592.

[8] *Meteorologische Zeitschrift*, July, 1914, pp. 358–359.

[9] See *Scientific American Supplement*, September 19, 1914, p. 179.

[10] See *Nature*, London, August 6, 1914, p. 592.

SPECIAL ARTICLES

SOME PHYSICAL PROPERTIES OF THE CELL NUCLEUS

Investigations on the physical properties of protoplasm have received fresh impetus through the introduction by Kite[1] of Barber's pipette holder for dissection purposes. By means of fine glass needles manipulated in this holder it is possible to undertake the dissection of fresh tissue under the highest magnification of the microscope.

My results in cell dissection largely substantiate Kite's general statements on the consistency and physical make-up of protoplasm.

In this paper I wish to present the results of studies made on the nucleus of the male germ cells of the grasshopper, *Disosteira Carolina*,

[1] G. L. Kite and Robert Chambers, Jr., "Vital Staining of Chromosomes and the Function and Structure of the Nucleus," Science, N. S., XXXVI., p. 639, 1912; G. L. Kite, "Studies on the Physical Properties of Protoplasm," *Am. Jour. Phys.*, XXXII., p. 146, 1913.